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The prevalence of speeding and drink driving in two cities in China: a mid project evaluation of ongoing road safety interventions

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ABSTRACT

Road traffic crashes in China kill in excess of 250,000 people annually, more than any other country in the world. They are the fourth leading cause of premature death in the country and are responsible for 2.4% of the burden of non-fatal health loss in the country. Interventions to curb speeding and drink driving are being implemented in the cities of Suzhou and Dalian since late 2010. We evaluated the ongoing effect of these activities through five roadside surveys, seven rounds of observational studies, and analysis of crash statistics in the two cities. We find that thus far, the prevalence of speeding has not reduced in either city with the notable exception of one site in Dalian, where the percentage of speeding vehicles declined from nearly 70% to below 10% after an interval-based speed enforcement system was installed. The broader deployment of such speed control technologies across China and other countries should be explored. Roadside alcohol testing suggests that prevalence of drink driving prevalence (i.e. BAC >20 mg%) declined from 6.4% to 0.5% in Suzhou and from 1.7% to 0.7% in Dalian during the monitored time period. However, the measured prevalence rates are very low and should be validated against estimates based on hospital studies. Roadside interviews suggest that the population of both cities is already highly sensitized to the risks associated with drink driving and speeding. Crash statistics from the two cities do not show appreciable declines in injuries and fatalities as yet. However, the possibility of substantial underreporting in crash statistics sourced from traffic police poses a severe threat to monitoring progress towards road safety in Suzhou, Dalian and across China. There is an urgent need for China to invest in a reliable road traffic injury surveillance system that can provide information for describing key risk factors, evaluating the impact of safety policies, and benchmarking achievements.

Introduction

Road traffic crashes killed 1.3 million people in 2010 globally and accounted for more than 3% of the total health lost due to illness and injury.[1-3] They were the eighth leading cause of death overall, and the leading cause of death among males aged 5-29 years. While low- and middle- income countries (LMICs) have rising road traffic death rates, high-income countries (HICs), which have a long history of road safety programmes, have death rates that are lower and have been declining steadily for several decades.[4]

Road traffic injuries killed 283,000 people in China in 2010, almost double the death toll (155,000) in 1990.[2] The corresponding death rate, 21.3 per 100 000 population, was more than double the death rate in Western Europe and the neighboring high-income region of Asia Pacific. Traffic crashes were the 4th leading cause of premature death in China in 2010. In addition to deaths, road traffic crashes result in substantial morbidity contributing 2.4% of the burden of non-fatal health loss in China.[1] There are more than 1.5 million people currently living with permanent disabilities in China resulting from road traffic crashes.[5]

The growth in road traffic crashes in the region has been fueled by an expansion of the road transport sector, which is closely linked with rapid economic growth.[6,7] China, which has seen sustained economic growth averaging more than 9% annually since 1985, now houses one of the world's largest intercity expressway networks, rivaling the US Interstate Highway System.[8] Although per-capita vehicle ownership levels are still relatively low at 0.05 private vehicles per person, the private vehicle fleet has increased by 90 times since 1990.[9]

Driven by a need to manage safety in a rapidly expanding road transport system, the Chinese government has undertaken several far-reaching initiatives to improve road safety in the

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country since 2003.[10,11] These include the preparation of a National Road Traffic Safety Plan that included specific safety targets to reduce fatalities and crashes. In 2004, the National People's Congress, China's top legislature, passed comprehensive road traffic safety legislation.[12] The law clarified the roles of various government agencies, assigning responsibility at the national level to the Ministry of Public Security, and to the Traffic Police at the local level. The accompanying Implementation Regulations[13] established leadership and coordinating groups, such as the Provincial and Municipal Road Safety Councils. Simultaneously, the Chinese Government significantly increased funding for road safety by financing programmes in the transport and health sectors. Notably, the National Highway Safety Enhancement Programme spent more than US$ 1.4 billion on identifying and eliminating crash black spots between 2004 and 2007.[10] In addition, a National Emergency Rescue System is being developed which focuses on the central and western provinces. Efforts have also been directed at improving infrastructure for monitoring and evaluation, such as through the establishment of the National Injury Surveillance System (NISS) in 2006.

The substantive increase in road safety activity in China has been accompanied by a parallel increase in road safety research and related academic publications. These studies highlight that police-based official statistics of road traffic crashes underreport road traffic deaths in China by a factor of three-to-six, based on comparisons with the Ministry of Health Vital Registration System and the national Disease Surveillance Points system.[6,14-16] Studies have also focused on specific risk factors. He et al.[11] reviewed the implementation and impact of speed control programmes since the 2003 road safety law. They concluded that China has undertaken a large number of speed control programmes using automated enforcement technologies that have not been reported in journal publications and have not been subjected to formal evaluation. Similarly, Li et al.[16] reviewed the legislations, current practices, and institutional capacities for preventing drinking and driving and concluded that the country has made substantive progress since the 2003 law by establishing strict laws, serious penalties, and rigorous enforcement programmes. Notably, Li et al. highlight that starting in 2011, new national legislation made drunk driving a criminal offense and introduced severe penalties for drink driving. These legislations have been coupled with strong enforcement across the country. Nevertheless, they concluded that effectiveness of these programmes cannot be formally assessed due to the absence of reliable data, a problem that has also been highlighted by other authors.[6,14]

In addition to this growing national focus on road safety in China, there has also been international interest in addressing the problem. In 2010, a consortium of partners received funding from the Bloomberg Philanthropies for a road safety project that aimed to improve road safety in 10 low-and-middle income countries including China.[17,18] In China, the project aims to support the government in implementing locally appropriate and sustainable programmes on the prevention of road traffic injuries and deaths through enhanced enforcement of legislation and social marketing campaigns. A central focus of these efforts is to reduce drink driving and speeding in the cities of Suzhou and Dalian. The intervention activities include recommending improvements of existing road safety policies, strengthening law enforcement capacity, educating the general public through social marketing, and building the capacity on road safety among local professionals. The following activities of this project are of particular note:

- 2011: March to November: General awareness raising campaigns on the risks of drink driving and speeding were undertaken in both cities. The primary focus of these activities was on health education, advocacy and communication through various mass media outlets.
- 2012: September to November: A 100 day social marketing campaign related with drink driving was implemented in Suzhou and was accompanied with increased police enforcement activities. A campaign titled "*Slow Down – Save a Life*" was implemented in Dalian.

In this paper, we report on the current (mid-project) status and the impact of these drink driving and speeding interventions in Suzhou and Dalian. We assess the changes in knowledge, attitudes, and practices of people towards drink driving and speeding in the two cities as reported in periodic roadside interviews. We evaluate changes in the prevalence of drink driving and speeding in the two cities as measured in periodic observation studies. Finally, we assess the change in road traffic crashes and injuries reported by traffic police in the two cities. Thus, we attempt to evaluate whether the introduction of the interventions are leading to road safety improvements in the two cities.

Data Collection Methods

We collected primary data in Suzhou and Dalian via observational studies and roadside knowledge, attitude and perceptions (KAP) surveys of drink driving in Suzhou and Dalian. The Institutional Review Board (IRB) at the Johns Hopkins Bloomberg School of Public Health and the China CDC approved all primary data collection in this study. In addition, we obtained secondary data on injuries from the local traffic police. Our data collection began shortly after the programme began in late 2010 and was conducted periodically thereafter (Table 1).

We measured trends in prevalence of drink driving by conducting periodic observation studies in conjunction with ongoing police enforcement activities in the two cities. Police conduct regular enforcement activities by setting up roadblocks and administering breathalyzers to measure blood alcohol content (BAC) levels of vehicle drivers that the police suspected might be driving under the influence of alcohol. Trained researchers from the local China CDC offices worked with police at these enforcement sites to record the number of drivers stopped, the number of "drink drivers" (defined as those with BAC between 20 mg% and 80 mg%) and the number of "drunk drivers" (defined as BAC >80 mg%). Over the course of this project, the police enforcement sites have shifted from targeting locations of high prevalence of drink driving (such as near bars and restaurants) to sites that are more randomly distributed across the city. We conducted seven rounds of measurements in each city usually between 7 pm and midnight between February 2011 and August 2012, and collected information on over 45,000 drivers (Table 1).

Similarly, we measured trends in speeding by conducting periodic observation studies at eight sites in Suzhou and six sites in Dalian. The sites were picked to allow for a range of road-types (urban and peri-urban, varying speed limits, divided and undivided) and geographic locations across the two cities. The precise locations of sites on these roads were chosen so that vehicle speeds would be primarily an outcome of driver choice and not affected by environmental conditions. Thus, these were chosen to be far from speed impediments (such as due to the presence of a bus stop, or due to active driveways with turning vehicle). At each site, trained researchers used radar speed guns to record vehicle speeds of all vehicles during a certain period of time. Researchers worked with police in order to comply with local road laws and for safety. In Suzhou, all measurements were conducted using a police-owned tripod-mounted radar gun and video recorder that transmitted speed and images

Table 1
Sample sizes and dates for data collection in Suzhou and Dalian, December 2010-September 2012.

Round	1	2	3	4	5	6	7
Drink driving							
Roadside Surveys – Suzhou							
Date	Feb-11	Sep-11	Nov-11	May-12	Aug-12		
Interviews	848	718	695	733	716		
Roadside Surveys – Dalian							
Date	Apr-11	Aug-11	Nov-11	Jun -12	Sep-12		
Interviews	614	630	609	600	602		
BAC Measurements – Suzhou							
Date	Feb-11	May, 2011	Sep-11	Nov-11	Feb-12	May-12	Aug-12
Sites	25	24	19	29	23	15	36
Drivers checked	2,421	2,624	1,588	5,107	4,188	3,718	3,856
BAC Measurements – Dalian							
Date	Dec-10	Jun-11	Aug-11	Nov-11	Feb-12	May-12	Aug-12
Sites	23	6	10	12	30	70	35
Drivers checked	1,766	1,210	1,309	1,450	4,460	7,955	3,500
Speeding							
Roadside Surveys – Suzhou							
Date	Feb-11	Sep-11	Nov-11	May-12	Sep-12		
Interviews	744	732	713	604	777		
Roadside Surveys – Dalian							
Date	Apr-11	Aug-11	Nov-11	Jun-12	Sep-12		
Interviews	609	625	605	606	605		
Speed Measurements - Suzhou							
Date	Mar-11	Jul-11	Sep-11	Nov-11	Mar-12	Jun-12	Aug-12
Vehicles	1304	1455	1365	5954	8000	8000	8000
Speed Measurements - Dalian							
Date	Apr-11	Jun-11	Aug-11	Nov-11	Feb-12	Apr-12	Jul-12
Vehicles	1215	1240	1241	6183	8270	8261	8257

wirelessly to the researchers at remote location a short distance away. The arrangement allowed the researchers and police vehicles to be concealed from drivers during the measurement process. In Dalian, where police did not have similar equipment, measurements were conducted from inside a police car using a radar gun. The police car had a flashing lightbar so as to be in compliance with local regulations. We conducted seven rounds of measurements in each city between March 2011 and August 2012 (Table 1).

We monitored the evolution in knowledge, attitudes, and practices of road-users towards drink driving and speeding in Suzhou and Dalian through five rounds of KAP surveys in each city between February 2011 and August 2012 (Table 1). The survey sites are chosen to be in the same district as the observation sites for drink driving and speeding. We developed these surveys and they consisted of a list of 30 questions for each risk factor, including general questions about drink driving and speeding behaviors, knowledge of legal drinking limits and speed limits, and specific questions about whether the respondents had been exposed to the social marketing campaigns.[19] Trained researchers from the local China CDC office conducted the interviews in collaboration with local police, who assisted in randomly stopping vehicles from traffic, explaining the purpose of the survey, and then redirecting them to the data collectors. Interviewers then explained to the drivers about the project, requested consent to participate, and then administered the survey to those who agreed, taking 10 minutes per vehicle, on average.

Finally, we obtained secondary data on road traffic crashes and injuries from the traffic police to track road safety outcomes in the two cities. This included monthly statistics on road traffic crashes, non-fatal injuries and fatalities and their attribution to speeding or drink driving by the traffic police.

Results

Drink Driving

The prevalence of drink driving has declined in both Suzhou and Dalian between December 2010 and August 2012. In Suzhou, 5.7% of the drivers were found to be drink driving (BAC of 20-80 mg%) and 0.7% (BAC >80 mg%) were found to be drunk driving in February 2011 during the first round of drink driving measurements (Table 2). Starting in September 2011, drink driving prevalence showed a substantial and statistically significant decrease in drink driving. These reductions have been sustained in all subsequent measurements. Drunk driving measurements show a similar and sustained decline. In Dalian, baseline measurements of drink driving in December 2010 were much lower than those in Suzhou (1.6% drink driving and 0.06% drunk driving). The percentage of drink drivers continuously reduced over 2011 and these statistically significant declines were sustained through the most recent measurements in August 2012, by when drink driving decreased to 0.74%. By the most recent round, drunk driving had also shown a statistically significant decline to 0.00%.

In both cities, a large proportion (usually >90%) of the respondents claim that they either never drink or they did not drink if they drive (Table 3). This statistic has not changed substantively during the period of these measurements. The proportion of respondents that felt that they would be almost certainly caught if they were to drink under the influence is

Table 2
Observed prevalence of drink driving in Suzhou and Dalian over time

Suzhou							
Date	Feb-11	May-11	Sep-11	Nov-11	Feb-12	May-12	Aug-12
% drink driving	5.66%	5.41%	1.64%	0.63%	0.62%	0.67%	0.52%
(change)	-	(-0.2%)	(-4.0%)*	(-5.0%)*	(-5.0%)*	(-5.0%)*	(-5.1%)*
% drunk driving	0.70%	2.36%	0.38%	0.22%	0.26%	0.16%	0.44%
(change)	-	(+1.6%)	(-0.3%)	(-0.5%)*	(-0.4%)*	(-0.5%)*	(-0.3%)
Dalian							
Date	Dec-10	Jun-11	Aug-11	Nov-11	Feb-12	May-12	Aug-12
% drink driving	1.64%	1.40%	1.22%	0.69%	1.52%	1.11%	0.74%
(change)	-	(-0.2%)	(-0.4%)	(-1.0%)*	(-0.1%)	(-0.5%)*	(-0.9%)*
% drunk driving	0.06%	0.17%	0.15%	0.14%	0.04%	0.00%	0.00%
(change)	-	-0.10%	-0.10%	-0.10%	0.00%	(-0.1%)*	(-0.1%)*

Drink driving corresponds to BAC of 20-80 mg%; Drunk driving corresponds to >80 mg%
* Change that is statistically significant at 5% significance level; compared to Round 1

Table 3
Knowledge, attitudes, and practices related with drink driving in Suzhou and Dalian (Selected responses from roadside surveys).

	Suzhou					Dalian				
	Feb-11	Sep-11	Nov-11	May-12	Aug-12	Apr-11	Aug-11	Nov-11	Jun-12	Sep-12
Interviews	848	718	695	733	716	614	630	609	600	602
Q1. Which of the following statements best describes your attitude toward drinking and driving?										
I don't drink at any time	35%	33%	36%	31%	42%	47%	48%	48%	41%	40%
If I am driving, I don't drink	56%	60%	59%	55%	48%	47%	45%	49%	54%	56%
If I am driving, I restrict what I drink	4%	5%	3%	6%	4%	4%	4%	3%	5%	5%
If I am driving, I do not restrict what I drink	0%	1%	1%	1%	0%	0%	1%	0%	0%	17%
Don't know or refuse to answer	5%	2%	1%	6%	7%	2%	1%	1%	0%	0%
Q2. If you were driving under the influence of alcohol, what do you think your chances are of getting caught?										
Less than 30% (very unlikely)	21%	12%	9%	12%	13%	19%	13%	7%	13%	4%
Between 30-50% (somewhat unlikely)	20%	22%	25%	31%	17%	18%	15%	14%	12%	16%
Between 50-80% (very likely)	24%	27%	32%	20%	27%	18%	24%	29%	28%	35%
More than 80% (almost certain)	25%	26%	33%	24%	23%	38%	34%	45%	36%	39%
Don't know	10%	14%	1%	13%	20%	8%	14%	5%	11%	7%
Q3. Do you know the legal limit for driving under the influence of alcohol in your (state/province/ country)?										
Yes	22%	35%	33%	29%	35%	17%	20%	27%	36%	45%
Q4. Have you heard any messages about drink driving recently?										
Yes	77%	79%	71%	54%	65%	83%	62%	67%	62%	70%

about ten-percentage points higher in Dalian than in Suzhou. In both cities, this proportion grew by a few percentage points during the first three rounds before declining in the next two. The proportion of respondents that felt that they were very unlikely to be caught showed the opposite trend. In Suzhou the proportion of respondents that claimed to know the legal drinking limit has stayed steady at approximately one-third. However, in Dalian this proportion has steadily increased from 16.8% in the first round to 45.5% in the most recent round. Finally, the proportion of respondents who claimed to have recently heard messages about drink driving did not show any steady trends and averaged at slightly higher than two-thirds.

Speeding

In Suzhou, the proportion of vehicles driving above the speed limit (Figure 1a) is relatively low. At the time of the Round 1 baseline data collection (March 2011), 13.5% of drivers exceeded the posted speed limit, and only 2.4% drove at a speed that was 30% higher than the speed limit. These proportions have not changed substantially over the seven rounds of measurement, which concluded in August 2012.

However, the proportion of vehicles driving above the speed limit varies considerably across specific observation sites. While the proportion of vehicles at Baodai never exceeded 5% in any of the rounds, at several sites (Jinjihu, Xiandaidadao, Beihuan) more than one-third of vehicles were found to exceed the speed limit in one of the rounds. Two of the sites (Taihudadao and Beihuan) show large and steadily increasing levels of speeding from only about 10% of vehicles driving over the speed limit in March 2011 to more than 30% in August 2012.

The proportion of vehicles driving above the speed limit in Dalian is considerably higher than Suzhou (Figure 1b). At the time of the baseline data collection in May 2011, 31.8% of drivers exceeded the posted speed limit, and 9.1% drove at a speed that was 30% higher than the speed limit. By July 2012, these proportions had dropped to 9.3% and 0.3%, respectively. Figure 2 illustrates that in Dalian, the proportion of vehicles driving substantially in excess of the speed limit has declined substantially and steadily since September 2011. This is not the case in Suzhou.

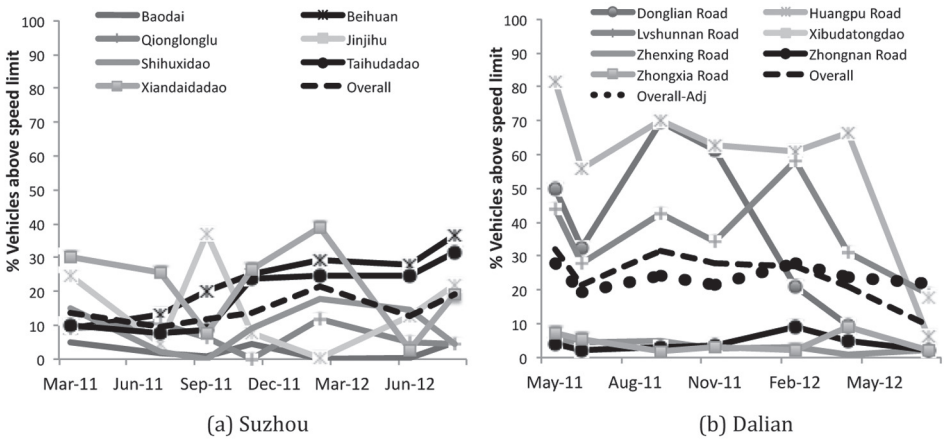

Figure 1. Prevalence of speeding (i.e. driving above the speed limit) at each observation site in Suzhou, (a), and Dalian, (b).

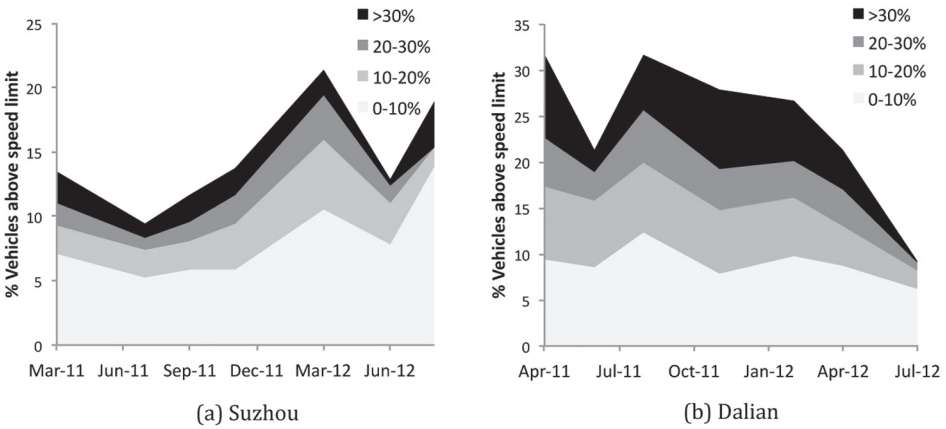

Figure 2. Extent of speeding at observation sites in Suzhou, (a), and Dalian, (b).

However care should be taken in interpreting these aggregate because of substantial differences across specific sites. In three sites (Zhongxia Road, Zhongnan Road, and Zhenxing Road), the proportion of vehicles speeding did not exceed 10% in any of the rounds. In contrast, the proportion of vehicles speeding at Huangpu Road, Donglian Road, and Lvshunnan Road exceeded 30% in most rounds. At Donglian, the proportion of vehicles speeding decreased over four rounds of measurement from 69.5% in Sept 2011 to 9.5% in April 2012. At this site, an interval-based speed enforcement was deployed by local authorities likely contributing to the observed declines in speeding. In the seventh round, the site at Donglian was dropped from the study and replaced with a site at Xibudatongdao. The dramatic decline in speeding at Huangpu Road in Round 7 coincides with an increase in speed limit from 50 km/h to 70 km/h. In the absence of these changes (i.e. eliminating the change associated with Donglian and holding the Huangpu speed limit at 50 km/h), overall speeding (Overall-Adjusted in Figure 1b) does not show a decline over the time period of our measurements.

Most respondents in both cities somewhat disagreed or strongly disagreed with the statement that fines for speeding were mainly intended to raise government revenue, with proportions in most rounds exceeding 70% (Table 4). These proportions have not changed appreciably over the five rounds of surveys. In both cities, approximately 80% of respondents somewhat disagreed or strongly disagreed with the statement that it was okay to exceed the speed limit if they were driving safely. Similarly, these proportions did not change appreciably over the five rounds of surveys. Although more than 90% of respondents in both cities agreed that speeding was a cause of road traffic crashes, 12-21% of respondents admitted to having received a speeding ticket in the last year, and 1-10% of respondents claimed to have been involved in crashes because of speeding in the last year. The distribution of these responses has not changed substantially over the five rounds of surveys.

Road Injury Outcomes

Police data are the only source of citywide data on injuries and fatalities in these two cities. Figure 3 illustrates trends in deaths and non-fatal injuries from road traffic crashes in Suzhou and Dalian compared with national statistics. Although deaths in 2011 in both cities were lower than in 2010, non-fatal injuries in Suzhou increased slightly. However, both graphs show secular declining trends for both cities and at the national level since 2008 that predate the introduction of the programme.

Discussion

Our overall findings for drink driving and speeding in Suzhou and Dalian during this period of time suggest improvements. However, these preliminary results should be interpreted with caution. Our observation studies suggest that the prevalence of drink driving in both cities shows statistically significant declines from the baseline measurements (February 2011) that had been sustained until the most recent measurements in August 2012. While these declines are encouraging, care should be taken in attributing them to the local social marketing campaigns.

Table 4
Knowledge, attitudes, and practices related with speeding in Suzhou and Dalian (Selected responses from roadside surveys).

	Suzhou					Dalian				
	Feb-11	Sep-11	Nov-11	May-12	Sep-12	Apr-11	Aug-11	Nov-11	Jun-12	Sep-12
# of interviews	744	732	713	604	777	609	625	605	606	605
Q1. Fines for speeding are mainly intended to raise revenue for the government										
Strongly agree	5%	3%	5%	4%	3%	7%	9%	4%	8%	3%
Somewhat agree	13%	12%	13%	8%	21%	9%	11%	9%	16%	7%
Indifferent	9%	14%	13%	14%	17%	6%	12%	11%	8%	6%
Somewhat disagree	29%	28%	31%	27%	34%	17%	24%	26%	27%	28%
Strongly disagree	45%	43%	39%	47%	25%	58%	42%	49%	42%	56%
Q2. I think it is okay to exceed the speed limit if you are driving safely										
Strongly agree	3%	2%	3%	1%	2%	4%	7%	4%	4%	2%
Somewhat agree	14%	13%	15%	10%	10%	11%	11%	13%	12%	4%
Indifferent	3%	3%	4%	4%	3%	1%	6%	4%	4%	3%
Somewhat disagree	28%	31%	30%	29%	45%	16%	25%	29%	24%	28%
Strongly disagree	51%	49%	47%	52%	34%	67%	49%	50%	56%	62%
Not sure	2%	2%	1%	5%	6%	2%	2%	2%	1%	2%
Q3. Would you agree that speeding is a cause of road traffic crashes?										
Yes	93%	90%	92%	94%	89%	92%	93%	95%	96%	94%
Q4. In the past year, have you received tickets for speeding?										
Yes	16%	16%	21%	17%	21%	15%	14%	16%	12%	21%
Q5. In the past year, have you been involved with a crash because of speeding?										
Yes	7%	5%	3%	1%	4%	7%	10%	6%	8%	5%

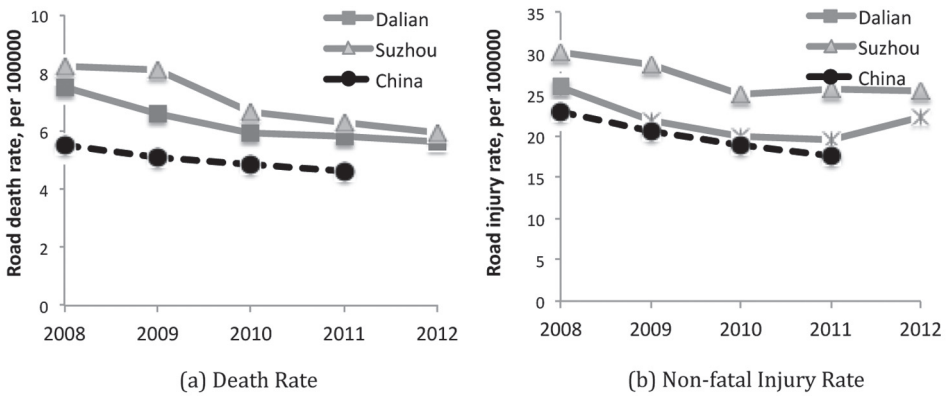

Figure 3. Rates of deaths, (a), and non-fatal injuries, (b), due to road traffic crashes in Suzhou, Dalian, and China.

Notably, much of the decline in drink driving rates in both cities occur prior to August 2011, i.e. prior to the social marketing campaigns. Furthermore, these declines coincide with a major national legislative change in May 2011 that criminalized drink driving and which was aggressively enforced. The new national law, which was preceded by several months of publicity, is one explanation for why the baseline prevalence of drink driving was already low, especially in Dalian, where only 1.6% of drivers were found to be drink driving.

The potential for bias in police-based data collection is another explanation for our unexpectedly low measurement of the prevalence of drink driving. Other studies from China that have worked with police to measure drink driving (such as random breath tests done in Guangxi province in 2006-2007)[16] have also reported low prevalence of drink driving compared with other countries. However, in other settings, such as the US, this proportion is more than ten times higher.[20] There are several sources of potential bias in our measurements. Conducting these measurements in conjunction with police enforcement activities makes it difficult to impose a rigorous, protocol-based, measurement process. Drivers may already know about the existence of police checkpoints in advance. Further, our measurements rely on police identifying drivers that are suspected of driving under the influence, which can lead to undercounting of drink drivers. Finally, the trends observed in our measurements may have been affected by changes in policing methods. These evolved from enforcement near bars and restaurants to more random locations across the city during the study period. This shift in study population provides another explanation for the declining trends in drink driving observed. Therefore, alternate data sources that can provide independent estimates of the magnitude and trends of the drink-driving problem in Suzhou and Dalian are needed. In particular, hospital-based injury surveillance systems that measure alcohol use among road traffic crash victims may be useful to estimate the extent and trends in drink driving crashes.

Our speed measurements in Suzhou show that the overall prevalence of speeding in the city is relatively low, which may be because of the existence of a vast network of automated speed enforcement cameras across the city. Although the aggregated prevalence estimates did not show a time trend, the disaggregated data suggests increasing trends in speeding at two sites. In contrast to Suzhou, in Dalian, which does not have an extensive network of speed enforcement cameras, the prevalence of speeding was much higher. While the aggregated prevalence estimates suggest a dramatic decline in speeding in Dalian, this is due to three reasons: (1) a dramatic reduction in speeding at Donglian Road, where an interval-based speed enforcement system was recently deployed; (2) a 20 km/hr increase in the speed limit at Huangpu; and (3) the replacement of the Donglian site with Xibudatongdao. While the Donglian Road reduction is a speed enforcement success story, the effect of the other two is to create an artificial improvement in our overall speed observations.

The success of speed control at Donglian Road deserves further explanation. Donglian is an urban, limited-access, elevated highway zone. It is 11.3 km long, has three lanes/direction, has a speed limit of 60 km/hr, and primarily carries car traffic. An interval-based speed enforcement system was installed and tested at Donglian Road by local authorities from January 2012 to April 2012 and used for speed enforcement starting May 2012. The system uses 19 high-resolution cameras on exit/entry ramps to record license plate numbers. Speed limit violations are determined by comparing the duration that vehicles spend within the enforcement zone with the time required for a vehicle traveling at the speed limit. The effect of the enforcement was to cause the percentage of vehicles traveling at speeds >10% above the posted speed limit on Donglian Road to decline from 49.5% to 2.7%, while percentages remained relatively stable at other sites and did not show any secular trends. The proportions of vehicles traveling >20% and >30% above speed limit on Donglian Road and the other sites varied similarly. These results suggest that interval-based speed enforcement systems can be effective in zone-wide speed reductions in China. A recent review of the literature found that in recent years interval-based speed enforcement systems have become popular throughout Europe and Australia and that a growing body of evidence suggests high rates of compliance with speed limits, reductions in average and 85th percentile speeds, reduced traffic speed variability, and reductions in fatal and serious injury crashes.[21] Further research is needed to understand the operational and political barriers to the widespread deployment of such systems worldwide.

There are limitations to our speed measurements. In both cities, local researchers used police equipment to conduct speed measurements. In Donglian, this required the use of a police car with flashing lights to be in compliance with local laws. The conspicuous police presence provided a warning to drivers and would likely have led to lower speeds.

Our approach uses three levels of evidence to monitor the interventions to reduce drink driving and speeding behaviors in the two cities. First, we evaluate what people say about their own behaviors and attitudes through roadside surveys. While these surveys do not show significant time trends, they suggest that the population is highly sensitized to both risk factors. However, self-reports may not reflect actual behavior.[22] Therefore, we conduct observational studies to provide a more reliable measure of the changes in behavior. With the caveats mentioned above, the drink driving observations suggest improvements in behavior, and the speeding observations suggest mixed results. However, the ultimate test of road safety interventions is their effect on eventual outcomes measured by crash statistics.

At the aggregate level, total road traffic injuries reported by the traffic police in the two cities do not show noticeable declines as yet. Crash statistics have a strong seasonal pattern that repeats annually. As a result, trends are most easily observed in crash statistics that have been aggregated annually. At this stage, only one full year of post-programme crash data is available from the two cities and this does not show a decline over the previous year. Disaggregated data attributing crashes to specific risk factors could provide a more sensitive indicator for evaluating the interventions. Unfortunately reliable data on risk factors is not available from police data in China. The proportions of crashes attributed to drink driving and speeding in the two cities in police data have never exceeded single-digit percentages, which is more than an order of magnitude smaller than expected. Not only does this provide a biased estimate of the incidence of crashes due to various factors, it also makes police data unusable for tracking the success of road safety programmes.

A more serious problem with the use of police data is severe underreporting of crash statistics. Several studies have shown that at the national level police data severely underestimate road traffic injuries and fatalities. National traffic police, the source of official government statistics on road traffic injuries, reported 65,225 deaths in the year 2010. However, two prominent global studies, GBD-2010[1-3] and WHO's 2013 Global Road Safety Status Report,[4] used the national Disease Surveillance Points system and the national death registration system to estimate the death toll to be more than four times the official number (283,000 and 276,000, respectively). We should expect similar underreporting in the city level traffic police data, which is the only source of data on injury outcomes available to our study, severely limiting our ability to evaluate the road safety interventions in the two cities. Studies to validate police records, for instance via capture-recapture studies, should be undertaken in Suzhou and Dalian. There is an urgent need for the most populous nation in the world to invest in a reliable road traffic injury surveillance system that can provide information for describing key risk factors, evaluating the impact of safety policies, and benchmarking achievements.

In summary, the social marketing campaigns to reduce drink driving and speeding in Suzhou and Dalian do not yet show clear effects on road safety outcomes. Although drink driving appears to have decreased, much of the decline occurred prior to the start of the interventions and was likely driven by national policy efforts. Similarly, the improvements in speeding behaviors are primarily a result of the Donglian enforcement system and cannot be attributed to the interventions being discussed here. Although it is possible that the continuing social marketing efforts will yield better results in time, it is likely that the poor outcomes observed are because the interventions thus far have focused too narrowly on changing human behaviors. The 2004 World Report on Road Traffic Injury Prevention[23] argued for a scientific approach to road safety management, driven by sound data analysis and multi-sector coordination of transport, health, urban planning, and law enforcement agencies, among others. Adopting a systems approach to the problem of road safety will likely yield strong dividends and would be consistent with the vision of the UN Decade of Action for Road Safety 2011-2020,[24] which calls for a managed system with safer roads, safer vehicles, safer road users, and better post-crash response.

Conflict of interest

The authors declare that they have no conflicts of interest related with this study

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